



# DESIGN FOR CUSTOMER SATISFACTION – A PROACTIVE APPROACH TO INPUT CUSTOMER EXPECTATIONS IN DESIGN PHASE

**Senthilkumar Ramakrishnan\***

Research Scholar Bharath Institute of Science and Technology, Chennai,

**K.R.Vijaya Kumar**

Professor, Department of Mechanical Engineering, Dr.M.G.R Educational and Research Institute, Chennai

**Dr.Naveen Chandran**

Head - Dept of Automobile Engineering  
Bharath Institute of higher Education & Research

\*Corresponding Author

## ABSTRACT

*This paper attempts to classify various possible reasons for customer satisfaction or dissatisfaction, especially focusing on Product Design. Taking an example of Automotive Industry. It further deep dives to understand customer expectations and how to ensure those elements are captured in the early design stage itself. It also suggests a method to fine-tune the current development model, to be proactive in securing customer satisfaction after the product is launched.*

**Key words:** Customer satisfaction, Defects, Dissatisfaction, Design for Quality, Design for Reliability, New Product Development

**Cite this Article:** Senthilkumar Ramakrishnan, K.R.Vijaya Kumarm and Dr.Naveen Chandran, Design for Customer Satisfaction – a Proactive Approach to Input Customer Expectations in Design Phase, International Journal of Mechanical Engineering and Technology, 10(01), 2019, pp.534–542

<http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=10&Type=01>

## 1. INTRODUCTION

In present trend the importance of customer satisfaction is been understood by all sort of organisations. The retaining existing customers constitutes less effort rather than gaining new customers. The satisfaction of the customer binds a link to overall performance of company and it also acts as measure in analysing the organizations performance in relation to requirements of customer [1]. In the past decade, Product Quality and Reliability were considered to be main drivers of customer satisfaction. But ever increasing competition and technology improvements

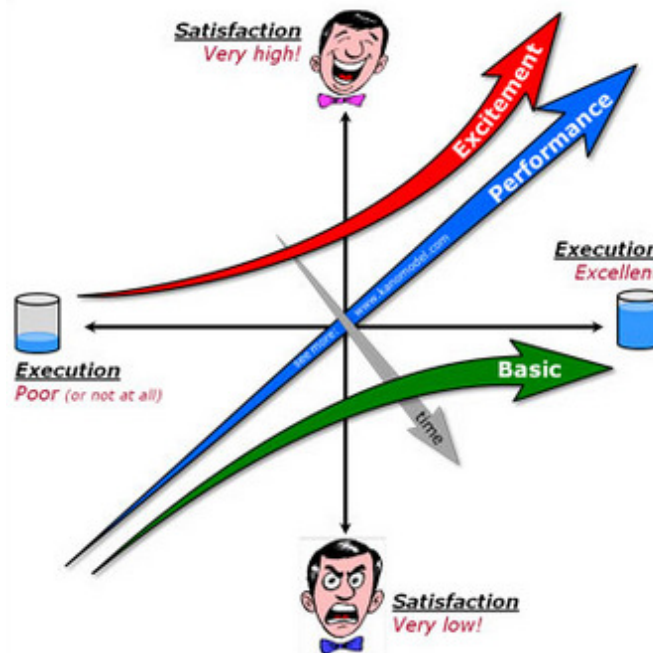
made sure that Product Quality and Reliability are a must for survival. So, eventually a company has to take more steps to satisfy the customers and to be able to create a differentiation in their Product and/or service offerings. This includes to understand various factors that can affect customer satisfaction and find a way to improve their offerings to meet or Customer expectations.

## 2. CUSTOMER SATISFACTION AND ITS IMPORTANCE

Customer satisfaction is a measure of how your organization's total product performs in relation to set a of customer requirements. Customers' choice determines the market share of manufacturer. To satisfy customer demands, manufacturers must understand what customers expects and how to address their expectation. As an integral part of the Design process, Reliability planning and specification should be driven by customer needs [2]

### 2.1. Levels of Expectations and Customer satisfaction

The expectations of Customers are divided into three categories; excitement wants, basic wants and performance wants. Basic wants are elementary expectations for performance of products. most fundamental expectations for the functionality of the product. Performance wants are customers' spoken expectations. Excitement wants indiactes represents probablel needs which enhances the customers [2]



**Figure 1:** Kano's model [2], by Prof. Noriaki Kano

#### 2.1.1. Basic Needs:

These are elementary expectations of Customers admitted for granted. If the expectations delight the customers they're neutral or else dissatisfied. It's also called as, "Must-be's" as they act price factor of products in market. The Examples like stiffness of the cups, hygiene in hotels and accuracy of the lock of car door which insist on purchasing the products.

#### 2.1.2. Performance Needs:

The performance needs of products make the customers think to their extremes while purchasing. The satisfaction depends on rate performance. The elements like battery performance of mobiles and resolution of TV or mobiles are categorised under this.

### 2.1.3. Excitement needs:

These needs play a major role in delighting the customers with unusual surprises. Some of the organizations name it as USP's (Unique Selling Propositions) like quality of Zappo's with their free shipping both ways and Nest's thermostat that programs itself

### 2.1.4. Indifferent:

The presence of absence of this type of needs is not given much importance which play a least role in customer satisfaction. These indicate some of the high end features of present mobile phones.

### 2.1.5. Reverse:

The presence of this needs causes dissatisfaction and absence of these makes customers happy. They are rarely found in a product and also includes attributes like "I hate when they do that".[2]

The Kano Model does not constitute any of these attributes. The quality of excitement of ones may be quality of performance to others and expectation of ones may be excitement to others.

## 2.2. Importance of Customer satisfaction

Customer satisfaction, or Dis-satisfaction when the Product doesn't meet expectations, can have serious effect of organization's business objectives. Dis-satisfied customers can take actions in public or in private, both will impact Brand image, thus also effecting sales. Typical reactions of a dis-satisfied customer is shown in below figure [3]. So, to be successful in any Industry, it is very important to understand customer expectations, design the product to meet or exceed expectations.

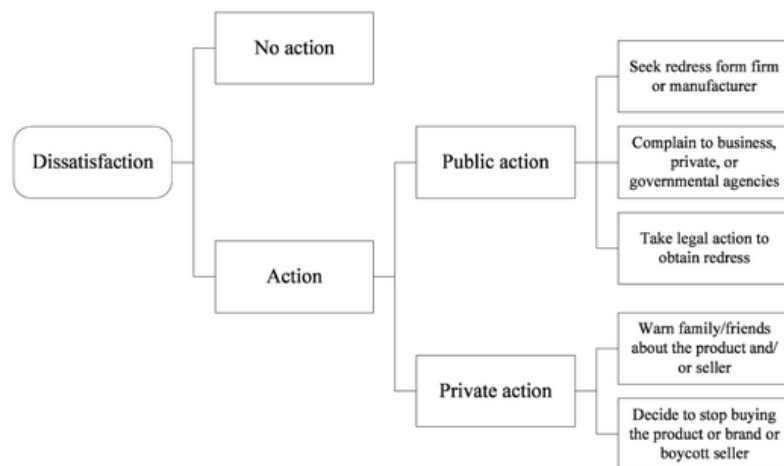


Figure 2: Importance of Customer satisfaction [3]

## 3. TYPES OF FAILURES IN PRODUCT THAT CAN LEAD TO CUSTOMER DIS-SATISFACTION

Typically customer dis-satisfaction comes when their expectation is not met. As this paper focuses on, how to ensure customer expectations are included in product design phase, the discussion will be limited to Dis-satisfaction arising out of Product Design. We will exclude other potential dis-satisfaction aspects like Service, Cost, etc. The Possibility of product not meeting customer expectation can be due to different parameters but generally classified in to two aspects;

- Defects, due to poor quality and/or reliability of a product

- Function or Features not meeting expectations, also called as Dis-satisfaction items

### 3.1. Defects, due to Poor Quality and/or Reliability

Defects can be defined as “Non-conformance of a product with the specified requirements, or non-fulfillment of user expectations” [4]. Defects are mainly linked to function and can arise due to following failure modes; [5]

- No Function*: System or Design is totally non-functional or inoperative
- Partial / Over Function / Degraded over Time*: Degraded performance. Meets some of the function requirements, but does not fully comply with all attributes or characteristics
- Intermittent Function*: Complies but loses some functionality or becomes inoperative often due to external factors such as temperature, moisture, environment, etc.,
- Unintended Function*: This means that the interaction of several elements whose independent performance is correct adversely affects the product or process. This will result in an unwanted outcome or consequence by the product, and hence the expression "unintended function"

#### 3.1.1. Why defects happens:

Defects can happen either due to Poor Quality of poor Reliability. Let's understand the meaning and difference between Quality and Reliability. ISO 8402-1986 standard defines Quality as *"the totality of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs"*. Quality guru Juran defines *"Quality is fitness for use or purpose"*. Quality or Poor Quality is often measured in Defect rate like, Percentage failure, Parts per Million (PPM), etc., Reliability is defined as *"Probability that a product performs its intended function, under specified conditions over a period of time"* [6]. In simple terms Reliability is, "Quality over a period of time"

Defects due to poor Quality, is often due to poor manufacturing processes or Inspection practices. Defects due to poor Reliability will likely happen over a period of time, which means customer may not be able to notice it when the product is new. Following table explains various types of defect that a product can have and how to eliminate it.

**Table 1** Failure type and Method of elimination

Defect or Failure type	Dependent upon	Eliminated by
Quality	Unrelated to Stress or Time	Inspection / Process Control
Reliability	Stress	Screening
Wear-out	Time	Qualification (Life) testing or Periodic Replacement
Design	Stress and/or Time Dependent	Proper Application, Selection and De-rating

### 3.2. Function or Features not meeting customer expectations (Dis-satisfaction items)

This is perhaps most difficult expectation of a customer to meet or exceed, as it varies customer to customer and also it's about customer perception. One feature expected by customer may be unnecessary to other customer. Nevertheless, it's absolute necessary to take care of this aspect of customer expectation, to be ahead of competition. Customer satisfaction by enlarge is a combination of "Product being defect and dis-satisfaction free. However, it's impossible to meet all customer expectations, so as to trade either with other features or sometimes customer is unaware of the how to use the feature, hence he sees it a defect. For example, a first time car buyer can face a Fogging issue in the windshield during the rainy season if he uses Air conditioner in the same way it's operated in a sunny day. Once customer faces such issue, he will project it as a failure. However, it's the responsibility of manufacturer to educate customer on all features in the car and how to operate it under various conditions. This is also called as "Customer education. In Automotive Industry, where lot of efforts have been made to understand customer perception, so that manufacturer can either meet it or work on customer education. Mostly it is done through surveys, by the company themselves or through external agencies. Let's take an example of Initial Quality Study of cars, called as IQS.

### ***3.2.1 Initial Quality Study – Example of capturing customer expectations and feedback***

The present work consists of analytic and broad information helping the organizations in understanding the issues of product quality. Basic survey is being carried out for 2-6months of ownership in understanding the problems. The analysis is also concentrated on the problems mainly to assure the quality. Summarization of Overall performance is done with "Problems per 100 vehicles" (PP100) designations. The study is done through Face to Face Interview of customers, with a 228 questions with 8 vehicle categories mentioned below [7];

- Exterior
- Seat
- Driving Experience
- HVAC (Heating, Ventilation, Air Conditioner)
- Feature control display
- Interior
- Audit Navigation
- Engine, Transmission

### ***3.2.2. Limitations in current practice of capturing Customer expectations in Design phase***

Current Quality and Reliability assurance practice ensures the Product is designed and validated to be defect free. However for Dis-satisfaction items, most of the companies are in reaction mode, as it's a perception issue and all feedback cannot be predicted during Design and Development. For example, Survey results are used to understand PPH (Problems per Hundred vehicles) level and Product's position with respect to competitors. Actions are taken considering relative ranking, as every car will have some PPH (It cannot be Zero), also called as Industry average.

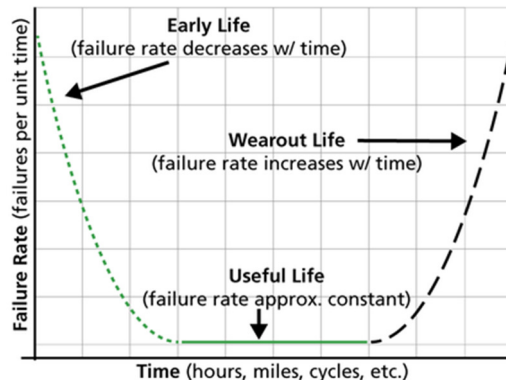
## **4. PROPOSED APPROACH TO ENSURE CUSTOMER SATISFACTION IN DESIGN PHASE**

### **4.1. Design for Reliability, to avoid or minimize defects**

Defects that can come during life of the product to be properly estimated and eradicated in design to meet or exceed customer expectations. Intention is to optimize the Design to reduce Failure rate in different stages of life namely; Early life, Useful life & Wear out life. Product Design shall

be fully validated to ensure it meets Reliability targets that are driven based on customer expectations [8]

Most products exhibit failure characteristics as shown in the bathtub curve of the following figure;



**Figure 3:** Bathtub curve – Representation of Product Life cycle

The above graph consists product life on abscissa and failure rate on ordinate. Life can be quantified in minutes, hours, years, cycles and actuations and any other time unit. The rate of failure is taken as failures among surviving units per unit time. The above plot indicates that there is higher failure rate at beginning of many products (because of manufacturing defects, poor workmanship, poor quality control of incoming parts, etc.) and decrement of failure rate and stability is achieved to constant rate in life region in which failures are known as chance of failure. The wear and tear rate plays a major role in rate of failure and also population rise experiences failure in relation to wear out. The human mortality rate is the best example as it is higher during starting and decreases to low constant level in teenage and adult life and rises in progression of years. [9]

According to the above bathtub curve, the shipping of products would be best at beginning of life region, rather than right off the production line; which prevents the customers from early failures. This practice commonly known as "burn-in", and is frequently performed for electronic components.

Failure rate, using 3 parameter Weibull distribution is given by [9]

$$\lambda(t) = \frac{f(t)}{R(t)} = \frac{\beta}{\eta} \left( \frac{t-\gamma}{n} \right)^{\beta-1} \quad (1)$$

Where;

$n$  = scale parameter

$\beta$  = shape parameter (or slope)

$\gamma$  = location parameter

$t$  = Time

#### **4.1.1. Systematic approach to capture all customer expectations and Field conditions to design Reliability program**

Though existing development methodology already covers major portion of Design for Reliability, including collecting voice of customers and Benchmarking, still there are gaps in terms of designing proper Reliability program to take in to account all aspects of Validation requirements and Life data analysis. Below proposal covers all such aspects integrating customer needs, field conditions and Design limits [10], [11]

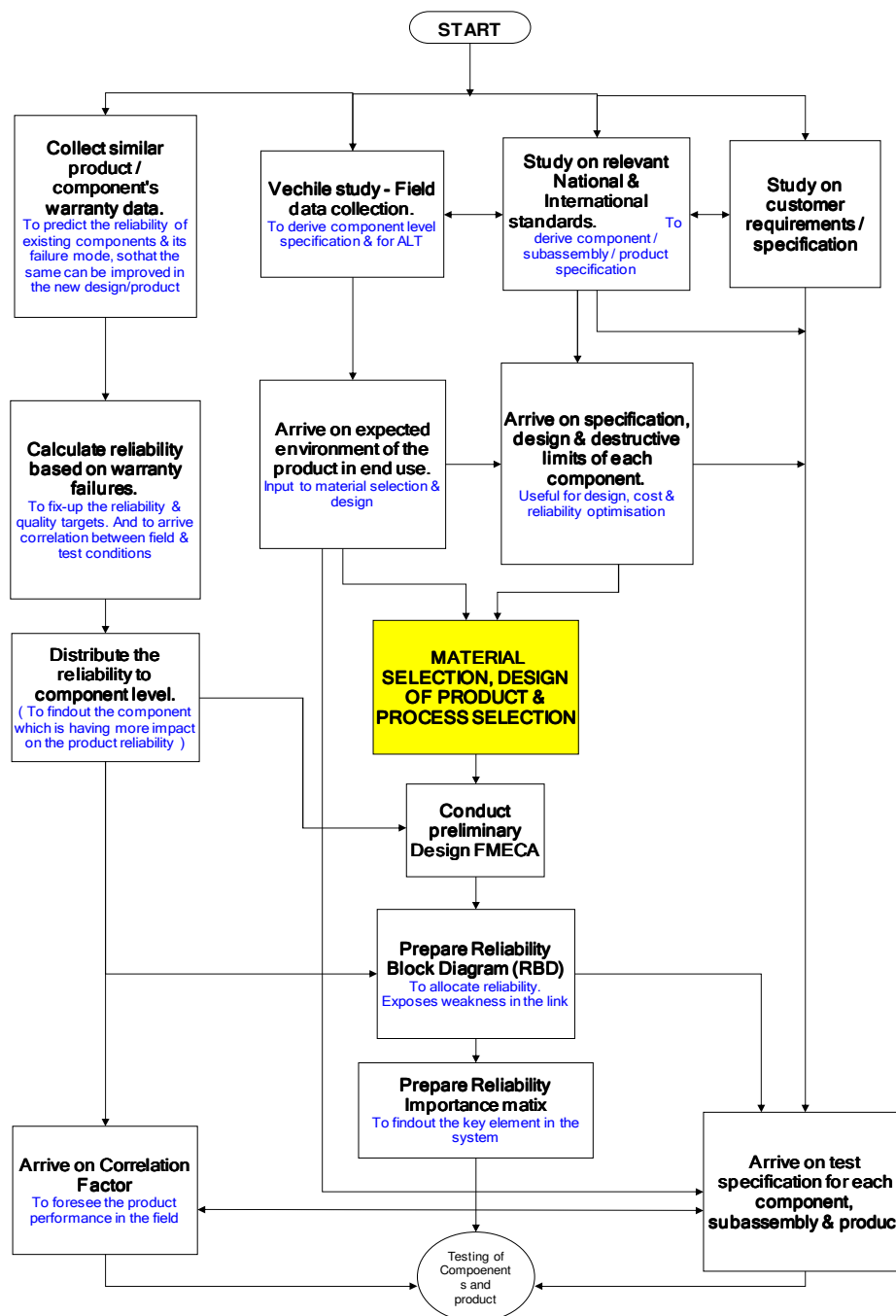


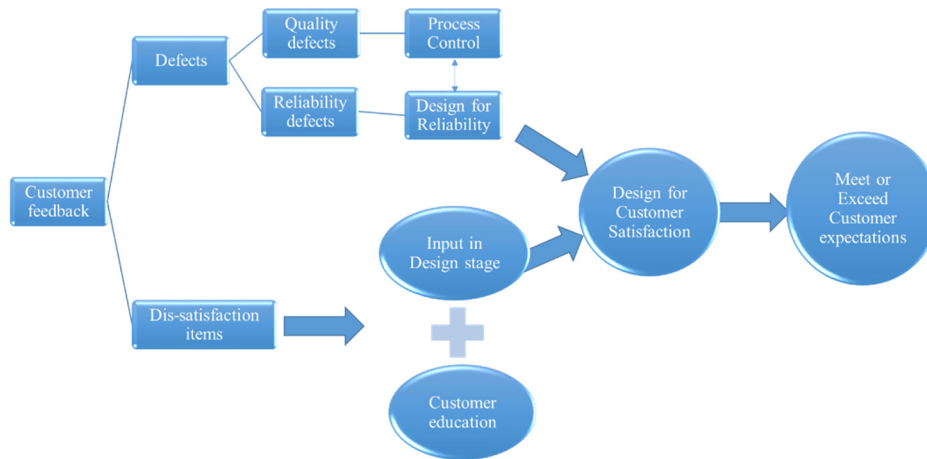
Figure 4: Systematic Reliability program

#### 4.2. Minimize or Avoid Perception and Dis-satisfaction items

By adopting approach explained in Fig 4, can help Organization to avoid defects due to Reliability & Quality failures, however it does not take in to account the complete customer expectations. For example, it doesn't cover perceived quality issues and want of features and/or functions, as expected by customers. Those elements can generally be found in customer surveys. Hence the company has to give at most importance to such surveys, to hear customer voice in similar product either own product or competitors. This can give huge amount of data about customer expectation and perception about the product and its features. Those inputs have to be carefully taken in to account during design of a new product. For example, during Quality surveys,

customer complains about Improper positioning of Air condition vent or Difficulty to access the Handbrake lever. This input to be considered while designing the new product. But the same time, Organisation has to carefully decide, which areas they would like to improve and other areas to be covered by educating customers to position the product appropriately, thus eliminating customer perceptions

## 5. CONCLUSION



**Figure 5** Integrated model of Design for Customer satisfaction

Customer satisfaction is one of the key elements to be successful in the market and to stay ahead of competitors. To gain customer satisfaction, it is essential that the Product Design is capturing all customer expectations, stated or Implied, Quality or Reliability or Perceptions. To do so, above suggested integrated model can be useful, to capture Voice of customer to cover all expectations, Inputting those in Design phase itself and validate the products using appropriate test methods. It shall also be noted that some customer perceptions to be addressed through customer education, as shown in Fig 5, not necessarily by improving the product. The decision of what to input in Design and what to manage through customer education to be taken case-by-case considering product positioning and nature of customer perception.

## Compliance with Ethical Standards

**Disclosure of potential conflicts of interest:** Author did not receive any research grants for this research.

**Statement of human rights:** “For this type of study formal consent is not required.”

**Research involving human participants and/or animals:** “This article does not contain any studies with human participants performed by any of the authors.”

**Informed consent:** “Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.”

## REFERENCES

- [1] Nigel Hill, Jim Alexander, 2006, “Handbook of Customer satisfaction and Loyalty Measurement, Third edition”, Gower publishing Limited, pp 2
- [2] [www.kanomodel.com](http://www.kanomodel.com)
- [3] Evangelos Grigoroudis, Yannis Siskos, 2009, “Customer satisfaction Evaluation”, Science & Business Media, pp3



- [4] [Joseph M. Juran](#), 1999, “Juran’s Quality Handbook”, Mcgraw Hill International Editions, pp 25
- [5] FMEA Handbook
- [6] Guangbin Yang, 2007, Life cycle Reliability Engineering, John wiley & sons, pp1
- [7] <http://india.jdpower.com/resource/india-initial-quality-study-iqs>
- [8] Developing Reliability requirements, Volume 12, Number 3
- [9] Dana Crowe, Alec Feinberg, 2001, “Design for Reliability”, CRC press, pp57,69
- [10] David M.Anderson (2010), “Design for Manufacturability - How to Use Concurrent Engineering to Rapidly Develop Low-Cost, High-Quality Products for Lean Production”, CRC Press, pp 47
- [11] AIAG (Automotive Industry Action Group), "Advanced Product Quality Planning manual 4th edition
- [12] Moch Bisyri Effendi, Increase Customer Satisfaction of Public Market in Indonesia with Non-Linear Sem-PLs, International Journal of Civil Engineering and Technology, 9(7), 2018, pp. 1394–1402
- [13] Saha, V. and Sharma, A. Investigation of Customer Loyalty and Customer Satisfaction with respect to Corporate Social Responsibility: A model for the Indian Banking Industry. International Journal of Management (IJM), 6(9), 2015, pp. 93-101.
- [14] Dr. Charusheela Birajdar and Prof. Akshata Joshi, A Review of Customer Satisfaction for Indian Postal Services. International Journal of Marketing and Human Resource Management, 7(3), 2016, pp. 49–59.
- [15] Dr. D. Rajasekar and Dr. A. Krishna Sudheer, A Study on Customer Satisfaction towards 'Ruler Pipes Pvt Ltd, Andrapradesh, International Journal of Mechanical Engineering and Technology 8(11), 2017, pp. 628–634.
- [16] G. Chandramowleeswaran and Dr. K. Uma, A Study on Customer Service Evaluation In Securing Customer Satisfaction. International Journal of Marketing and Human Resource Management, 6(3), 2015, pp. 75- 82.